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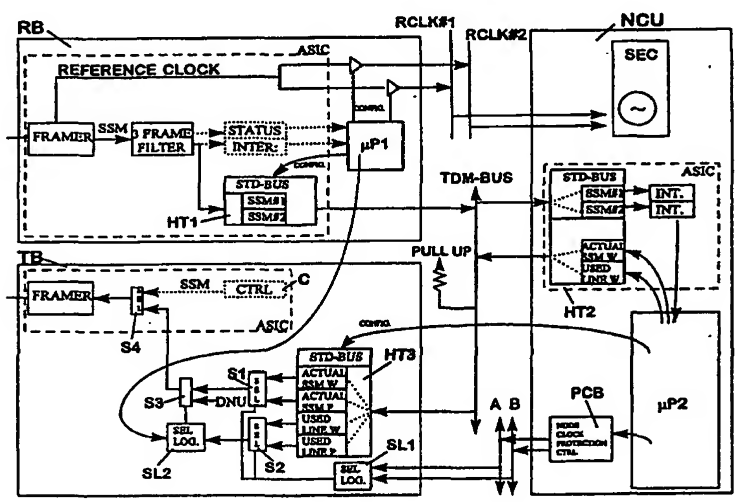

(57) Abstract

The invention relates to an access node in a telecommunications network, comprising: receiving blocks (RB) for receiving signals including reference clock signals and associated synchronization messages (SSM), a node control unit (NCU) for receiving the synchronization messages (SSM), the priority of the synchronization messages (SSM) being evaluated in this unit (NCU) by a software unit (µP2), and transmitting blocks (TB) for outputting the synchronization message (SSM) with the highest priority to connected elements, the synchronization message (SSM) being forwarded to the transmitting blocks (TB) by the node control unit (NCU). In order to allow a fast transfer of changed synchronization messages, the access node further comprises a TDM-bus for exchanging synchronization messages (SSM) between said receiving blocks (RB), said node control unit (NCU) and said transmitting blocks (TB). The invention equally relates to a method for a fast forwarding of synchronization messages (SSM), making use of a TDM-bus.

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Access node in a telecommunication system

The invention relates to an access node in a telecommunications network, comprising a) a plurality of receiving blocks for receiving signals including reference clock signals and associated synchronization messages from connected elements, especially tributary units, of the telecommunication system, the receiving block comprising each a framer for extracting the synchronization messages from the received signals, b) a node control unit for receiving the synchronization messages from at least one selected receiving block and for supplying a synchronous equipment clock signal synchronized with the reference clock signal corresponding to the synchronization message with the highest priority to all connected elements of the access node, the priority of the synchronization messages being evaluated in the node control unit by a software unit, and c) at least one transmitting block for outputting the synchronization message assigned to the presently used reference clock signal to connected elements of the telecommunication system, the synchronization message being forwarded to the transmitting block by the node control unit. The invention equally relates to a method for forwarding synchronization messages within a telecommunication network from a receiving block via a node control unit to a transmitting block, the receiving block receiving the synchronization messages from connected elements, especially tributary units, and the transmitting block transmitting a selected

synchronization message to connected elements, especially tributary units.

In synchronized or partly synchronized telecommunications networks, each access node comprises a node control unit for synchronized clock supply. To this end, each node control unit includes a stable local synchronous equipment clock synchronized to an input reference clock signal. The outputted signal of the synchronous equipment clock is used by all tributary units assigned to the node control unit as clock signal for processing. In each access node, selected reference clock signals originating from tributary units or node control units of the same or other access nodes that can be used for synchronization of the synchronous equipment clock are distributed to the node control unit via receiving blocks and reference clock lines. The node control unit of the access node, which controls the synchronous equipment clock, selects in a selection process the reference clock signal which is the best for use as reference for synchronization. For the selection process, synchronization messages (SSM) transmitted as software based messages from the receiving blocks to the node control unit and assigned to the different reference clock signals can be used to trace the best synchronization source in an access node with several input reference clock signals. Synchronization messages are used especially in ring networks in order to prevent timing loop situations, in which the access node tries to synchronize to the clock signal which is generated by itself. The synchronization message of the reference clock signal that has been selected by a node control unit for synchronization is then transmitted as software based message to transmitting blocks and from there to tributary units of the same access node or to any element of another access node. Synchronization

messages and reference clock signals may also come from and be passed on to some external elements.

The conventional method for transferring synchronization messages from receiving blocks to transmitting blocks via the node control unit of an access node is illustrated in figure 3.

Reference signals consisting of reference clock signals and synchronization messages enter receiving blocks RB associated to tributary units or node control units. A software unit µP2 included in the shown node control unit NCU selects different receiving blocks RB that are to provide the received reference clock signal to reference clock lines RCLK#1,RCLK#2. Software units µP1 of the selected receiving units send the synchronization messages corresponding to the transmitted reference clock signals as software based messages to the software unit µP2 of the node control unit NCU. In the software unit µP2 there is stored a prioritization table assigning to each possible message a quality level and, for the case of the same code of different messages, assigning additionally to different sources different priorities. The software unit µP2 of the node control unit NCU decides which of the received synchronization messages has the highest priority by evaluating the messages according to the prioritization table, in order to be able to select the corresponding reference clock line RCLK#1 for synchronization of the synchronous equipment clock SEC. This synchronization message is then send as one broadcast message or as separate software messages to the software units µP3 of several transmitting blocks TB. All units are equipped with a powerful microprocessor

µP1, µP2, µP3 communicating with each other via a communication channel, e.g. an ethernet based communication channel.

The disadvantage of forwarding a change in a synchronization message from a receiving block via a node control unit to one or more transmitting blocks with software messages is that it is a rather slow proceeding, which may result in problems concerning the required switching times

It is an object of the invention to provide an access node in a telecommunications system and a method for a telecommunications system allowing a fast transfer of changed synchronization messages.

This object is achieved according to the invention with an access node in a telecommunications network according to the preamble, further comprising a TDM-bus for exchanging synchronization messages between said receiving blocks, said node control unit and said transmitting blocks.

The object is equally achieved with a method for forwarding synchronization messages within a telecommunication network from a receiving block via a node control unit to a transmitting block, the receiving block receiving the synchronization messages from connected elements, especially tributary units, and the transmitting block transmitting a selected synchronization message to connected elements, especially tributary units, comprising the following steps:

- selecting receiving blocks that are to send their received synchronization message to the node control unit,
- writing the synchronization messages received by the selected receiving blocks to a TDM-bus by a hardware termination block comprised in the selected receiving blocks,
- reading the synchronization messages from the TDM-bus by a hardware termination block in the node control unit,
- determining which of the read synchronization messages is to be forwarded to the transmitting block,
- writing the determined synchronization message to the TDM-bus by the hardware termination block of the node control unit,
- reading the synchronization message written to the TDM-bus by the hardware termination block of the node control unit from the TDM-bus by a hardware termination block comprised in the transmitting block.

Using an access node and a method according to the invention, the system is enabled to react very fast, if the received SSM has been changed or if a defect signal is detected in the receiver.

In a preferred embodiment of the invention, receiving blocks, node control unit and transmitting blocks each comprise a hardware termination block for access to the TDM-bus.

The read and/or write access of the hardware termination blocks to the TDM-bus is best controlled by software units in the receiving block and in the node control unit.

Synchronization messages are transferred from selected receiving blocks via the TDM-bus to the node control unit. A fast hardware switching from the transmission of one selected synchronization message to the transmission of another from the node control unit to transmitting blocks is based on the pre-configuration made by the software unit of the node control unit. The software unit selects beforehand two references to be used according to the quality level of the synchronization messages received by the selected receiving blocks and according to prioritization tables. The updating of the prioritization tables are also made by the software unit.

In stable state, the synchronization message with the highest priority is forwarded from the node control unit to the transmitting blocks via the TDM-bus. In case of a change in the until now best synchronization message, the hardware is capable of transferring all necessary information between receiving blocks, node control unit and transmitting blocks, avoiding the need for slow IUC (inter unit communication) messages for switching to transmitting the synchronization message of the until now second best reference clock signal to the transmitting blocks.

After a switching by hardware the software will update the status of the selection process and configure the hardware according to the new quality levels of the synchronization messages associated with the reference clock signals. During this set-up phase the status of each potential synchronization port is checked using IUC-messages between the software units of the receiving blocks and the software unit of the node control unit. In the set-up phase, it is possible to use a slow

communication because of the long hold-off times of several minutes of recovered references.

Preferably, the TDM-bus is also used for transmitting a code identifying the reference clock line that is presently used for synchronization of the synchronous equipment clock from the node control unit to the transmitting block. This way, the transmitting block can verify, whether the reference signal on the used reference clock line comes from the same connected element to which the transmitting block is to output the synchronization message. This is of importance, since the outputting of this synchronization message might lead to timing loop situation, i.e. a unit might try to synchronize the signal it generates to the generated signal itself. Therefore, in case the connected element from which the used reference clock signal originates is the same as the one to which the synchronization message is to be forwarded, the transmitting block outputs a "do not use" message instead of the synchronization message.

Other advantageous embodiments of the invention can be taken from the subclaims.

A preferred embodiment of the invention is described in more detail with reference to drawings of which

Fig. 1 shows elements of an access node according to the invention,

Fig. 2 shows the read and write access of elements of an access node to a TDM-bus according to the invention, and

Fig. 3 shows the transfer of synchronization messages from receiving block via node control unit to transmitting block as employed in the state of the art.

Figure 3 has already been described with reference to the state of the art.

Figure 1 shows the node control unit NCU of an access node. The node control unit NCU has access to a plurality of receiving blocks of which one receiving block RB is shown. Equally, the node control unit NCU has access to a plurality of transmitting blocks of which one transmitting block TB is shown. An input port of the receiving block RB is part of a network element, and an output port of the transmitting block TB is also part of a network element. Possible components of the network element are tributary units or the node control unit NCU. The receiving block RB and the transmitting block TB may be located on the same network element.

In addition to receiving block RB, transmitting block TB and node control unit NCU, two reference clock lines RCLK#1,RCLK#2, control lines A,B and a TDM-bus can be seen in figure 1.

The receiving block RB comprises an input port connected to a framer. A first output of the framer is connected to a N frame filter N being between 1 and x, e. g. 3. The 3 frame filter has access via a first hardware termination block HT1 to the TDM-bus, the first hardware termination block HT1 being controlled by a first software unit µP1, which receives status information and interrupts from the 3 frame filter. A second output of the framer has access to the reference clock lines RCLK#1,RCLK#2 via drivers which are as well controlled by the first software unit µP1. Framer, 3 frame filter, hardware termination block

HT1 and STATUS/INTERRUPT providing means are realized as one ASIC.

The shown node control unit NCU comprises a synchronous equipment clock SEC, providing a clock signal for tributary units. The synchronous equipment clock SEC has access to reference clock lines, of which the access to two reference clock lines RCLK#1,RCLK#2 is shown. The node control unit NCU further includes a second hardware termination block HT2 with bi-directional access to the TDM-bus. The second hardware termination block HT2 itself comprises means for reading from and for writing to the TDM-bus and means for generating interrupts. The whole second hardware termination block HT2 is realized as one ASIC. The second hardware termination block HT2 communicates with a second software unit μP2 integrated in the node control unit NCU. The second software unit μP2 has access via a special protection control block PCB to control lines A,B. There is also provided a connection between the second software unit μP2 and the synchronous equipment clock SEC, which is not shown in the figure.

To the node control unit NCU there is associated a second node control unit, also not shown in the figure, comprising the same elements as the shown and described node control unit NCU. This second node control unit has moreover equal access to reference clock lines RCLK#1,RCLK#2, to control lines A,B and to the TDM-bus.

The transmitting block of figure 1 comprises a third hardware termination block HT3 controlled by the first software unit μP1 of the receiving block and including means for reading information transported by the TDM-bus. The third hardware termination block HT3 has an output

for the actual synchronization message ACTUAL SSM W of the working node control unit NCU, an output for the actual synchronization message ACTUAL SSM P of the protecting node control unit, an output for the used reference line USED LINE W of the working node control unit NCU and an output for the used reference line USED LINE P of the protecting node control unit. The outputs of the actual synchronization messages are provided to a first selector S1, the outputs of the used lines to a second selector S2. Both selectors S1,S2 have controlling inputs from a selector logic SL1 connected to control lines A,B. The output of the first selector S1 is supplied together with a DNU (Do Not Use)-code to a third selector S3, the third selector S3 being controlled by a selector logic SL2 receiving inputs from the second selector S2 and from the first software unit µP1 of a receiving block associated with the same reference signal source as the transmitting block TB. A synchronization message SSM provided by a control unit C is supplied as alternative input together with the output of the third selector S3 to a forth selector S4, the output of which is connected to the input of a framer. The output of the framer, finally, is connected to an output port of the transmitting block providing a connection to some network element. The framer and the forth selector S4 are integrated in one ASIC.

The TDM-bus, which is installed on the backplane, is provided with a resistor PULL-UP, which is used to force the transmission line to transmitting a code of "1"s, signaling "do not use", in the SSM time-slots, if no driver connected to the bus is activated. The impedance of a PULL-UP resistor is typically so high that is does not disturb the drivers.

The frame structure used for the transport by the TDM-bus is designed for the transportation of 36 bits, of which are reserved:

- 4 bits for the synchronization message SSM#1 of a first reference clock line RLK#1,
- 4 bits for the synchronization message SSM#2 of a second reference clock line RLK#2,
- 4 bits for the synchronization message of a third reference clock line RLK#3 (not shown),
- 4 bits for the synchronization message of a forth reference clock line RLK#3 (not shown),

transmitted from the receiving block RB to the node control unit NCU, and

- 4 bits for the ACTUAL SSM W of working node control unit NCU,
- 4 bits for the ACTUAL SSM P of protecting node control unit,
- 3 bits for identifying the reference line used USED LINE W by the working node control unit NCU for synchronization of node clock supply SEC,
- 3 bits for identifying the reference clock line USED LINE P used by the protecting node control unit for synchronization of node clock supply SEC,
- 3 bits for identifying the reference clock line used by the working node control unit for synchronization of clock supply for external elements, and
- 3 bits for identifying the reference clock line used by the protecting node control unit for synchronization of clock supply for external elements,

transmitted from one of the node control units (working or protecting) to the transmitting block TB.

The transmission of synchronization messages in a telecommunication network according to the invention is performed as follows:

A reference signal enters the receiving block RB and is processed in the framer. The framer splits up the received signal into reference clock signal and synchronization message SSM. The synchronization message SSM is filtered, and if there is a change in the message in three consecutive frames an interrupt and a change of status information is transmitted from the 3 frame filter to the first software unit μP1 of the receiving block RB. The synchronization message SSM is moreover passed on to the first hardware termination block HT1.

The depicted reference block RB was previously selected by the software unit μP1 of the node control unit NCU as one of four reference blocks that are to transmit their received synchronization message and their reference clock signal to the node control unit NCU.

Therefore, the first software unit μP1 enables the access of the reference clock signal to the assigned one of the reference clock lines RCLK#1,RCLK#2 by accordingly controlling the respective drivers. The first software unit μP1 moreover enables the first hardware termination block HT1 to write the code of the synchronization message SSM to the time slot reserved for the synchronization message SSM#1 of the reference clock signal transmitted by reference clock line RCLK#1. After the configuration, the first hardware termination block HT1 has direct access to the time slot on the TDM-bus.

The second hardware termination block HT2 of the node control unit NCU reads the data from all time slots reserved for synchronization messages from receiving blocks RB. The second software unit μP2 decides according to the quality level of the different synchronization messages SSM#1,SSM#2 and according to a prioritization table, which one of the read synchronization messages has the highest priority, e.g. SSM#1, and which one has the second highest priority, e.g. SSM#2. While there is no change in the code of the synchronization messages, the second software unit μP2 causes the synchronous equipment clock SEC to use the reference clock line RCLK#1 with the reference clock signal, to which the synchronization message SSM#1 with the highest priority is associated, for synchronization. Additionally, it causes the hardware termination block HT2 to write the presently used synchronization message SSM#1 to the TDM-bus and the code for the presently used reference line RCLK#1.

When the code of a synchronization message received by a selected receiving block RB and transferred via the TDM-bus changes, the second hardware termination block HT2 generates an interrupt which is forwarded to the second software unit μP2.

In case the second software unit μP2 is informed by an interrupt from the second hardware termination block HT2 that the synchronization message SSM#1 with the until now highest priority changed, it switches the synchronization source of the synchronous equipment clock SEC to the reference clock line RCLK#2 with the reference clock signal to which the synchronization message SSM#2 with the until now second highest priority is associated. It furthermore causes the hardware termination block HT2 to

write the synchronization message SSM#2, which used to have the second highest priority, to the TDM-bus as ACTUAL SSM W instead of the synchronization message SSM#1, which used to have the highest priority. Equally, the code for the used reference clock line USED LINE W, is changed from the code of reference clock line RCLK#1 to the code of reference clock line RCLK#2.

The transmitting block TB is configured by software in a way that the outgoing synchronization message is forwarded directly from the TDM-bus without any filtering and without being processed by another software unit, thereby avoiding software reaction time.

The third hardware termination block HT3 of the transmitting block TB reads the ACTUAL SSM W and the USED LINE W information transported on the TDM-bus. The transmitting block TB is configured by software in a way that the outgoing synchronization message is forwarded directly from the TDM-bus without any filtering and without being processed by another software unit, thereby avoiding software reaction time. The hardware termination block HT3 outputs both read codes ACTUAL SSM W and USED LINE W. The output of the ACTUAL SSM W signal is supplied as one input to the selector S3. As second input there is supplied a DNU (do not use) signal to selector S3. Which of the two inputs is to be selected is controlled by selector logic SL2. The selector logic SL2 determines by the output of the USED LINE W signal and an information by the software units of those receiving blocks associated with the same network element as the transmitting block TB, whether the reference signal used for synchronization by the synchronous equipment clock SEC is the reference clock signal provided by said network element. In this case, the DNU-signal has to be

forwarded by selector S3 in order to prevent timing loop situations, otherwise the synchronization message ACTUAL SSM W is selected.

There may arise problems, which make it necessary to have the possibility to provide the synchronization message SSM that is to be outputted by the transmitting block TB by software. Therefore, the output of the selector S3 is first supplied to a further selector S4 as a first input, a second input consisting in a synchronization message SSM supplied by software-based control unit C. The output of this selector S4 exits the transmitting block TB via a framer, in which the selected signal is integrated in a frame structure together with the reference clock signal used by the synchronous equipment clock SEC, for further use.

In a protected system, there is assigned to a working node control unit NCU a protecting node control unit able to take over the clock supply of connected tributary units in case of a detected failure in the working node control unit NCU. Such a protecting node control unit protecting the depicted working node control unit NCU is not shown in figure 1, but its structure is the same as the structure of the working node control unit NCU.

Just like the active node control unit NCU, the protecting node control unit reads synchronization messages from the TDM-bus and transmits the synchronization message with the highest priority ACTUAL SSM P and a code identifying the used reference clock line USED LINE P to the TDM-bus, from where it is read by the third hardware termination block HT3 together with the information provided by the active node control unit NCU.

The node clock protection control PCB of the presently active node control unit NCU outputs moreover a signal to control line A, informing that it is in control of the node clock supply. The node clock protection control of the presently stand-by node control unit outputs a signal to control line B, informing that it is in control of the node clock supply, as soon as it has taken over the node clock supply from the presently active node control unit NCU.

The third hardware termination block HT3 reads from the TDM-bus and outputs not only the ACTUAL SSM W and the USED LINE W codes, but also the ACTUAL SSM P and the USED LINE P codes. A selector logic SL1 in the transmitting block TB detects by the information received from control lines A,B, which node control unit is the presently active unit. The output of the selector logic SL1 is used for control of the selectors S1,S2, selecting the ACTUAL SSM W or ACTUAL SSM P code and the USED LINE W or USED LINE P code of the presently active node control unit from the two signals outputted respectively by the third hardware termination block HT3. The further treatment of the selected signals of the active node control unit is equal to the treatment described above for a single node control unit NCU. Normally, the working and the protecting node control units write the same information to the TDM-bus. Due to software processing delays the writing operations are not synchronized.

Figure 2 shows the read and write access of tributary units TU1-TU4 and node control units NCU1,NCU2 to an TDM-bus transporting synchronization messages. Four different tributary units TU1-TU4 output synchronization messages SSM REF#1 - SSM REF#4 assigned to four different

reference clock signals. The synchronization messages enter the active node control unit NCU1 and the stand-by node control unit NCU2 via receiving units (not shown) and a TDM-bus. The selected synchronization message ACT SSM(W), ACT SSM(P) of both is transferred back via the TDM-bus and transmitting units (not shown) to the tributary units, where the synchronization message of the presently active node control unit NCU1 is selected for further use. The selection takes place according to information on control lines A,B, stating which node control unit is presently the active and which the stand-by node control unit.

Analogously, information about the reference clock line used for synchronization of the synchronous equipment clock of active and stand-by node control unit as well as information about the line used for synchronization of a reference clock of active and stand-by node control unit NCU1,NCU2 for supply of external elements, is transferred from the node control units via TDM-bus to the tributary units TU1-TU4. Again, the information coming from the presently active node control unit NCU1 is selected according to information on control lines A,B for further use as described with reference to figure 1.

CLAIMS

1. Access node in a telecommunications network, comprising

- a plurality of receiving blocks (RB) for receiving signals including reference clock signals and associated synchronization messages (SSM) from connected elements, especially tributary units, of the telecommunication system, the receiving blocks (RB) comprising each a framer for extracting the synchronization messages (SSM) from the received signals,
- a node control unit (NCU) for receiving the synchronization messages (SSM) from at least one selected receiving block (RB) and for supplying a synchronous equipment clock signal synchronized with the reference clock signal corresponding to the synchronization message (ACTUAL SSM W) with the highest priority to all connected elements of the access node, the priority of the synchronization messages (SSM) being evaluated in the node control unit (NCU) by a software unit (µP2), and
- at least one transmitting block (TB) for outputting the synchronization message (SSM) assigned to the presently used reference clock signal to connected elements of the telecommunication system, the synchronization message (SSM) being forwarded to the transmitting block (TB) by the node control unit (NCU),

characterized in that

the access node further comprises a TDM-bus for exchanging synchronization messages (SSM) between said

receiving blocks (RB), said node control unit (NCU) and said transmitting blocks (TB).

2. Access node in a telecommunications network according to claim 1, **characterized in that**
- the receiving blocks (RB) comprise a first hardware termination block (HT1) with an access to the TDM-bus for writing the actual synchronization messages (SSM) to the assigned time-slots on the bus,
- the node control unit (NCU) comprises a second hardware termination block (HT2) with an access to the TDM-bus for reading the synchronization messages (SSM) on the TDM-bus and with an access to the TDM-bus for writing the synchronization message (ACTUAL SSM W) associated to the reference signal used for synchronization of the synchronous equipment clock (SEC) to an assigned time-slot on the TDM-bus, and
- the transmitting blocks (TB) comprise a third hardware termination block (HT3) with an access to the TDM-bus for reading the synchronization message (SSM) which is assigned to the presently used reference clock signal for synchronization by the node control unit (NCU) and written to the TDM-bus by the node control unit (NCU).

3. Access node in a telecommunications network according to one of the preceding claims, **characterized in that**

each receiving block RB comprises a software unit (µP1) for controlling the writing access of the first hardware termination block (HT1) to the TDM-bus.

4. Access node in a telecommunications network according to one of the preceding claims, **characterized in that** the second hardware termination block (HT2) of

the node control unit (NCU) comprises means for generating interrupts, if said second hardware termination block (HT2) determines a change in one of the synchronization messages SSM read from the TDM-bus, and means for outputting those interrupts to the software unit (μP2) included in the node control unit (NCU).

5. Access node in a telecommunications network according to one of the preceding claims, **characterized in that**
the software unit (μP2) of the node control unit (NCU) comprises means for selecting the receiving blocks (RB) that are to transmit their received synchronization message, means for evaluating the interrupts generated by the second hardware termination block (HT2) of the node control unit (NCU) and means for determining which of the synchronization messages read by the second hardware termination block (HT2) from the TDM-bus is to be written to the assigned time-slot on the TDM-bus as actual synchronization message (ACTUAL SSM W) associated to the reference signal used for synchronization of the synchronous equipment clock (SEC).

6. Access node in a telecommunications network according to one of the preceding claims, **characterized in that**
the software unit (μP2) of the node control unit (NCU) comprises means for controlling the reading access of the third hardware termination block (HT3) of the transmitting block (TB) to the TDM-bus.

7. Access node in a telecommunications network according to one of the preceding claims, **characterized in that**

each of the hardware termination blocks (HT1,HT2,HT3) is integrated in an ASIC comprised by receiving block (RB), node control unit (NCU) and transmitting block (TB) respectively.

8. Access node in a telecommunications network according to claim 7, **characterized in that** each ASIC comprises further elements of receiving block (RB), node control unit (NCU) and transmitting block (TB) respectively.

9. Access node in a telecommunications network according to one of the preceding claims, **characterized in that** the hardware termination block (HT2) of the node control unit (NCU) comprises means for writing a code (USED LINE W) identifying a reference clock line (RCLK#1,RCLK#2) transporting the reference clock signals used for synchronization of the synchronous equipment clock (SEC) to a reserved time-slot of the TDM-bus.

10. Access node in a telecommunications network according to one of the preceding claims, **characterized in that** that the hardware termination block (HT3) of the transmitting blocks (TB) comprises means for reading the code (USED LINE W) identifying the reference clock line (RCLK#1,RCLK#2) transporting the reference clock signals used for synchronization of the synchronous equipment clock (SEC) from the TDM-bus.

11. Access node in a telecommunications network according to one of the preceding claims, **characterized in that** that each transmitting block (TB) comprises means (S3,SL2) for substituting the synchronization message (SSM) that is to be outputted by the transmitting block

(TB) with a DNU (Do Not Use)-message, if the synchronization message is to be outputted to the connected element which is the original source of the synchronization message (SSM).

12. Access node in a telecommunications network according to one of the preceding claims, **characterized in that**

- the hardware termination block (HT2) of the node control unit (NCU) comprises means for writing a code identifying a reference clock line (RCLK#1,RCLK#2) transporting the reference clock signals used for synchronization of the generation of a reference clock signal in the node control unit (NCU) for clock supply to external units to a reserved time-slot of the TDM-bus,
- that the hardware termination block (HT3) of the transmitting blocks (TB) comprises means for reading the code identifying the reference clock line (RCLK#1,RCLK#2) used for the synchronization of the reference clock signal for external use from the TDM-bus, and
- that each transmitting block (TB) comprises means (S3,SL2) for substituting the synchronization message (SSM) that is to be outputted by the transmitting block (TB) with a DNU (Do Not Use)-message, if the synchronization message is to be outputted to an external element which is the original source of the synchronization message (SSM).

13. Access node in a telecommunications network according to one of the preceding claims, **characterized in that**

the TDM-bus has time slots reserved for the synchronsization messages (SSM#1,SSM#2) belonging to the reference clock signal that are transmitted by reference clock lines (RCLK#1,RCLK#2), for the synchronization message (ACTUAL SSM W) presently used for the synchronization of the synchronous equipment clock (SEC) and for a code assigned to the reference lines (RCLK#1,RCLK#2) used for the synchronization of the synchronous equipment clock (SEC) and for a code assigned to the reference lines (RCLK#1,RCLK#2) used for the synchronization of a clock generation for clock supply external elements.

14. Access node in a telecommunications network according to one of the preceding claims, **characterized in that**
the TDM-bus is connected to a resistor (PULL-UP) for forcing the code transmitted on the TDM-bus in the time-slots for the synchronization messages associated with the reference clock signal presently used for synchronization (ACTUAL SSM W) to a logical "one", if the first or the second hardware termination block (HT1,HT2) does not have a writing access to the TDM-bus.

15. Access node in a telecommunications network according to one of the preceding claims, **characterized in that**
- a protecting node control unit having equal access to the TDM-bus as the node control unit (NCU) is associated to the node control unit (NCU), and
- the TDM-bus has time-slots reserved for codes written to the bus by the protecting node control unit,
- the transmitting block (TB) comprises means for selecting from the codes read from the TDM-bus those

written to the TDM-bus by the presently active node control unit.

16. Method for forwarding synchronization messages (SSM) within a telecommunication network from a receiving block (RB) via a node control unit (NCU) to a transmitting block (TB), the receiving block (RB) receiving the synchronization messages from connected elements, especially tributary units, and the transmitting block (TB) transmitting a selected synchronization message (SSM) to connected elements, especially tributary units, comprising the following steps:

- selecting receiving blocks (RB) that are to send their received synchronization message (SSM) to the node control unit (NCU),
- writing the synchronization messages (SSM#1,SSM#2) received by the selected receiving blocks (RB) to a TDM-bus by a hardware termination block (HT1) comprised in the selected receiving blocks (RB),
- reading the synchronization messages (SSM#1,SSM#2) from the TDM-bus by a hardware termination block (HT2) in the node control unit (NCU),
- determining which of the read synchronization messages (SSM#1,SSM#2) is to be forwarded to the transmitting block (TB),
- writing the determined synchronization message (ACTUAL SSM W) to the TDM-bus by the hardware termination block (HT2) of the node control unit (NCU),
- reading the synchronization message (ACTUAL SSM W) written to the TDM-bus by the hardware termination block (HT2) of the node control unit (NCU) from the TDM-bus by a hardware termination block (HT3) comprised in the transmitting block.

17. Method according to claim 16, **characterized in that**
- a software unit (μP2) included in the node control unit (NCU) pre-selects the best and the second best synchronization message received from the selected receiving blocks (RB) according to the quality level transmitted by their code and according to a prioritization table stored and updated in the software unit (μP2), and that
- the software unit (μP2) of the node control unit (NCU) causes the hardware termination block (TB2) of the node control unit (NCU) to switch immediately from writing the synchronization message, which was the best according to preselection, to the TDM-bus to writing the pre-selected second best synchronization message to the TDM-bus in case of a change in the until then best synchronization message signalized to the software unit (μP2) by interrupts generated in the hardware termination block (TB2).

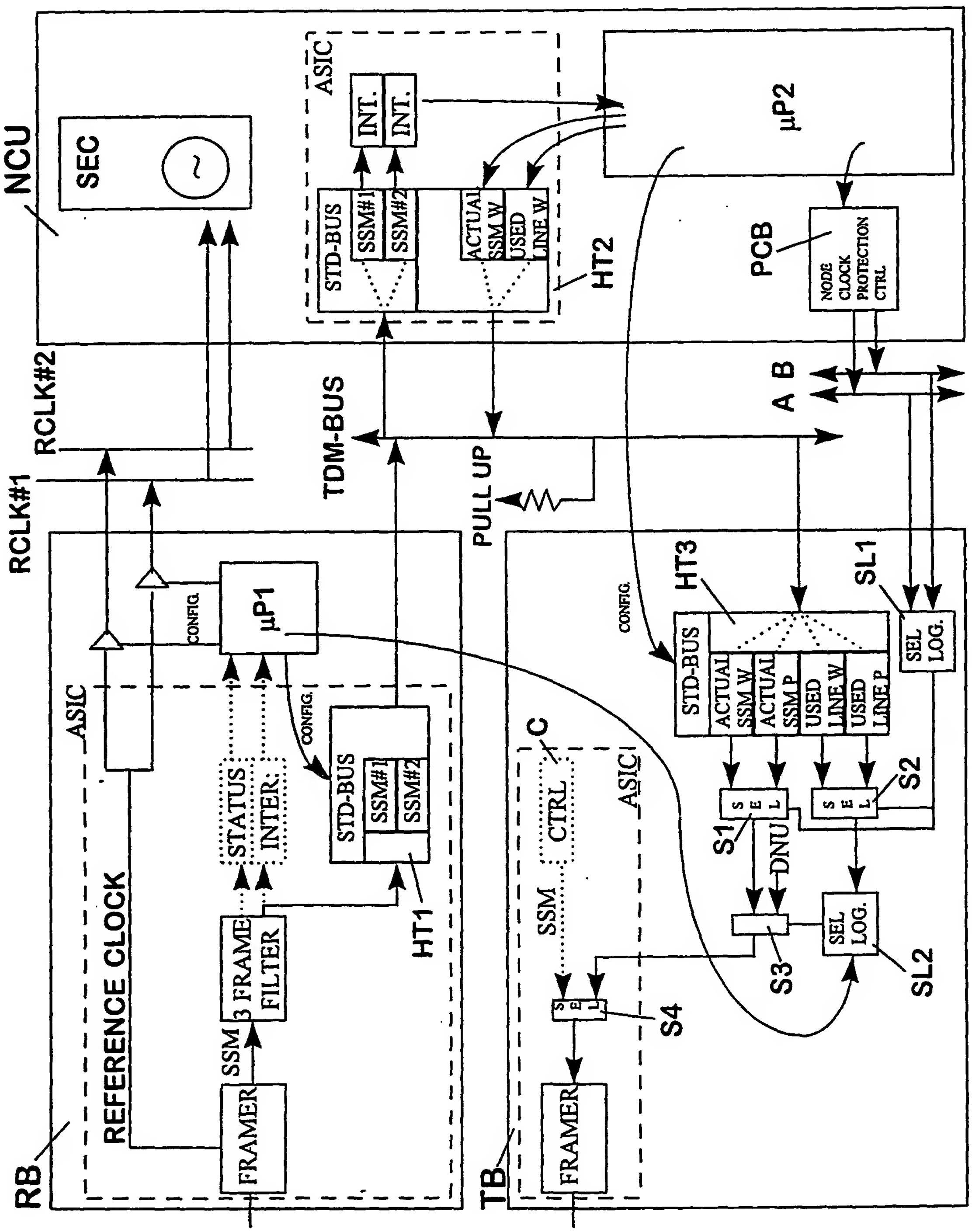
NCU
SEC
ASIC
INT.
INT.
STD-BUS
SSM#1
SSM#2
ACTUAL SSM W
USED LINE W
HT2
µP2
PCB
NODE CLOCK PROTECTION CTRL.
RCLK#2
RCLK#1
TDM-BUS
PULL UP
A
B
RB
REFERENCE CLOCK
ASIC
CONFIG.
µP1
STATUS
INTER.
CONFIG.
STD-BUS
SSM#1
SSM#2
HT1
SSM
3 FRAME FILTER
FRAMER
TB
C
CTRL
ASIC
SSM
S4
FRAMER
CONFIG.
HT3
STD-BUS
ACTUAL SSM W
ACTUAL SSM P
USED LINE W
USED LINE P
SL1
SEL LOG.
S1
SEL
DNU
S2
SEL
S3
SEL LOG.
SL2

FIG. 1

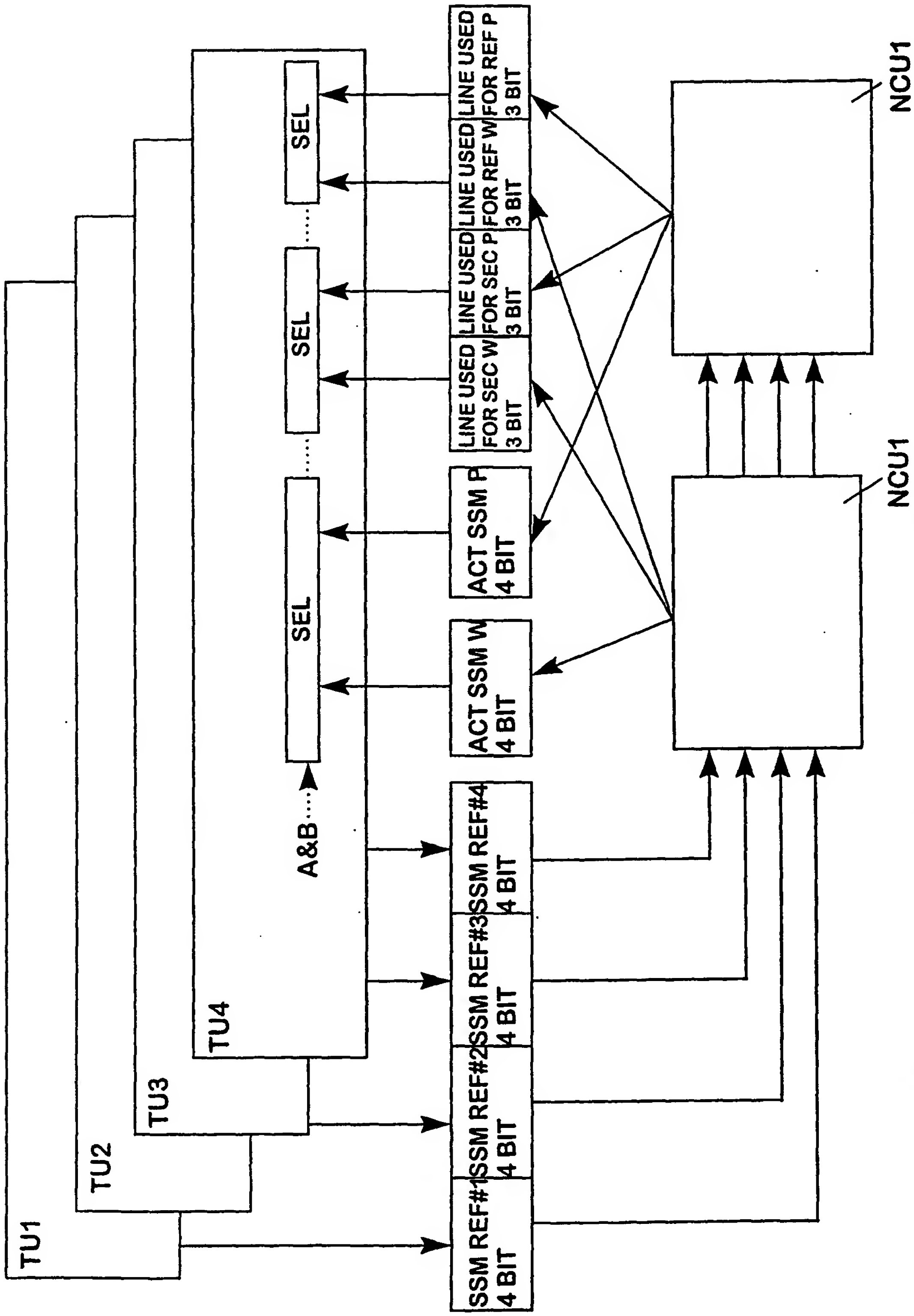
TU1
TU2
TU3
TU4
SEL
SEL
SEL
A&B
SSM REF#1 4 BIT
SSM REF#2 4 BIT
SSM REF#3 4 BIT
SSM REF#4 4 BIT
ACT SSM W 4 BIT
ACT SSM P 4 BIT
LINE USED FOR SEC W 3 BIT
LINE USED FOR SEC P 3 BIT
LINE USED FOR REF W 3 BIT
LINE USED FOR REF P 3 BIT
NCU1
NCU1

FIG. 2

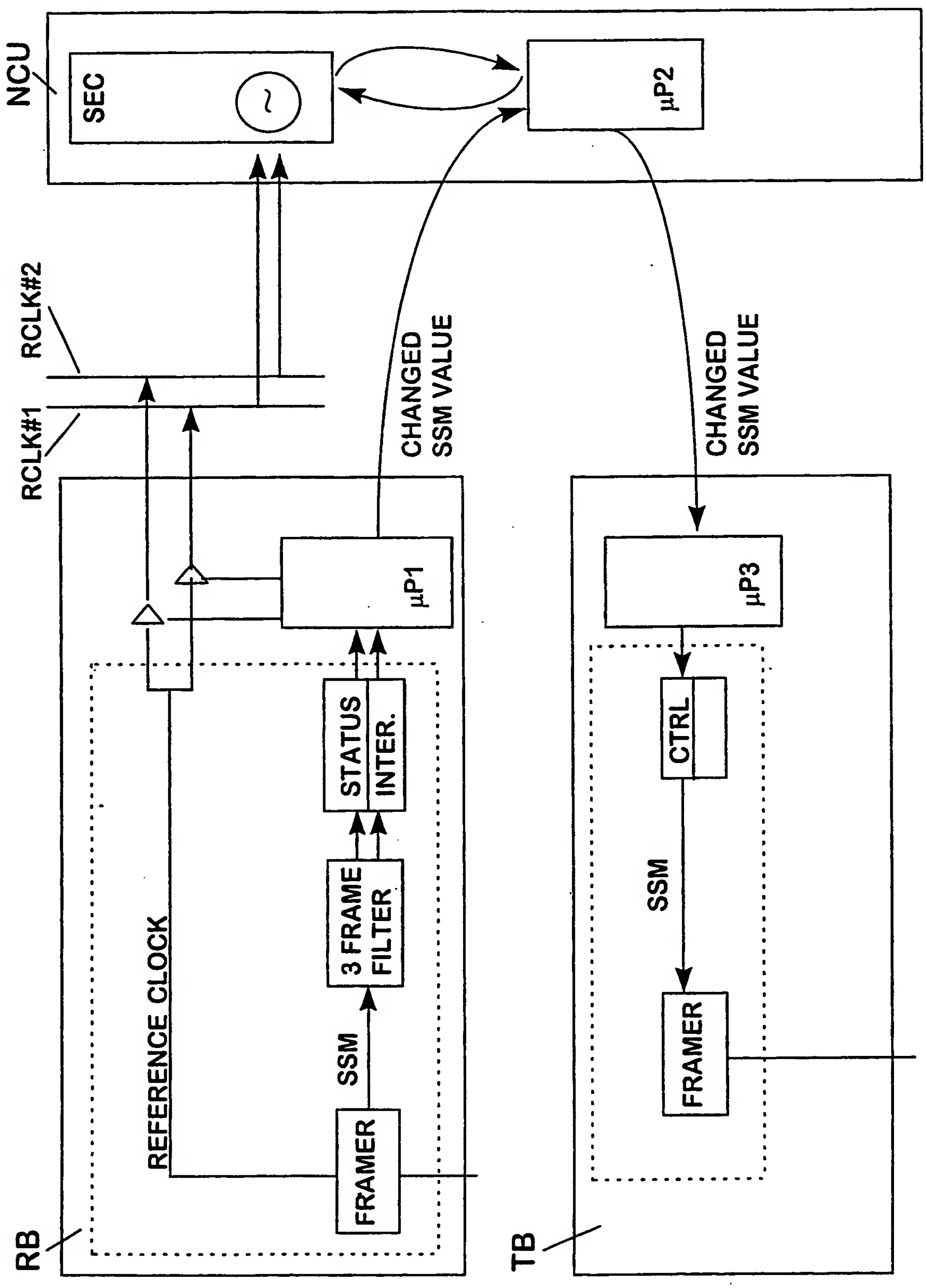
NCU
SEC
μP2
RCLK#2
RCLK#1
CHANGED SSM VALUE
CHANGED SSM VALUE
μP1
μP3
STATUS
INTER.
3 FRAME
FILTER
CTRL
SSM
SSM
REFERENCE CLOCK
FRAMER
FRAMER
RB
TB

FIG. 3

INTERNATIONAL SEARCH REPORT

In .onal Application No
PCT/EP 98/06119

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04J3/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H04J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 98 37651 A (KAINULAINEN JUKKA ;NOKIA TELECOMMUNICATIONS OY (FI)) 27 August 1998 see page 1, line 4-9 see page 1, line 31 - page 2, line 13 see page 2, line 24-31 see page 4, line 15-27 see page 15, line 3-34 ---	1-3,6,9,10,13,16
A	US 5 666 366 A (ROSE DENNIS M ET AL) 9 September 1997 see column 1, line 19-22 see column 2, line 44-62 see column 3, line 1-10 see column 3, line 53 - column 4, line 4 see column 4, line 50-63 see column 5, line 63 - column 6, line 10 --- -/--	6,9,10,13

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
7 May 1999	14/05/1999

Name and mailing address of the ISA	Authorized officer
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INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 98/06119

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 682 408 A (TANONAKA KOUJI) 28 October 1997 see column 1, line 10-15 see column 1, line 44 - column 2, line 7 see column 2, line 23-34 see column 6, line 17 - column 7, line 54 -----	1,16

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/EP 98/06119

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9837651 A	27-08-1998	FI 970700 A AU 5867698 A	20-08-1998 09-09-1998
US 5666366 A	09-09-1997	NONE	
US 5682408 A	28-10-1997	JP 7095677 A	07-04-1995